INFLUENCE OF COMPETITION ON THE RESPONSE OF IDAHO FESCUE TO CLIPPING

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INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION
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Contents

Abstract

Partly reducing competition increased by 40 percent the herbage volume produced by Idaho fescue (*Festuca idahoensis* Elmer) the following year and more than tripled the number of flower stalks. Eliminating competition almost tripled herbage volume and increased the number of flower stalks fourfold. The relative depressant effects of clipping were much reduced by concurrent reductions in competition. Partly reducing competition more than compensated for the effects of heavy clipping on herbage volume and flower stalk production, and eliminating competition more than offset the effects of extreme clipping. Volume increases caused by reducing competition resulted from increases in live basal area rather than stimulation of height growth. The number of flower stalks appeared to be a more sensitive indicator of plant vigor than either herbage volume or leaf and flower stalk lengths.

Introduction

Interpreting results from clipping studies on range plants is frequently confounded by the conditions under which the plants are clipped. Such studies are usually conducted in one of three ways: (1) clipping selected plants *in situ* without disturbing the surrounding vegetation; (2) clipping entire plots of vegetation and observing the reaction of selected species; and (3) clipping plants grown in pots without competing vegetation. Each approach imposes different stresses on the treated plants in addition to that of clipping. Obviously, clipping an individual plant without disturbing the surrounding vegetation subjects the weakened plant to much greater competition for moisture and nutrients than does clipping both the plant and the surrounding vegetation. Moisture and nutrient limitations to pot-grown plants would, of course, depend primarily upon the watering regimen and the amount and fertility of soil within the pot.

Different clipping studies reported for the same species often yield conflicting results. In many cases, these differences in plant response can be attributed to competition differences. For example, Hormay and Talbot[1] found that clipping Idaho fescue (*Festuca idahoensis* Elmer) to 1.5-inch stubble height during the flowering stage of growth reduced flower stalk production the following year by 95 percent and basal area by more than 85 percent. Apparently, the Idaho fescue was clipped as individual plants in unaltered surrounding vegetation. On the other hand, Mueggler[2] reported that

[1] *Hormay, A. L., and M. W. Talbot. Rest-rotation grazing . . . a new management system for perennial bunchgrass ranges. U.S.D.A. Forest Serv. Prod. Res. Rep. 51, 43 pp. 1961.*

[2] *Mueggler, W. F. Response of mountain grassland vegetation to clipping in southwestern Montana. Ecology 48(6): 942-949. 1967.*

Idaho fescue clipped to a 1-cm. stubble height at flowering, but with equal removal of surrounding vegetation, produced double the number of flower stalks and over 20 percent more herbage the following year.

The variable effects of competition are usually ignored in clipping studies. The investigator often justifies his actions by holding competition more or less constant in any one study and by expressing results in relative terms. Unfortunately, the results from such studies are often used on an actual rather than relative base and applied by the land manager to conditions where competition is completely different from that of the study. Is it correct to use herbage removal guides developed from species grown under full competition for the same species grown on range where competition from surrounding vegetation has been reduced by grazing? To answer this question, we must first know how much influence competition has on the effects of herbage removal.

This paper describes the results of a study that gives some indication of the relative effects of competition on the ability of Idaho fescue to withstand heavy and extremely heavy clipping.

Methods

The study area, a natural mountain grassland on Montana State University's Red Bluff Ranch in southwestern Montana, was part of a gently sloping broad, north-facing swale, approximately 6,000 feet in elevation. The soils, derived from granite, are fairly deep and productive. The vegetation, moderately grazed until the year of the study, was in good condition and protected from grazing during the course of the study. The vegetation was dominated by Idaho fescue, bluebunch wheatgrass (*Agropyron spicatum*), and lupine (*Lupinus argenteus*). Secondary species were more or less typical of those usually associated with the above in this part of Montana, and range from rose pussytoes (*Antennaria rosea*) to rabbitbrush (*Chrysothamnus nauseosus*). Wherever the vegetation and soils were disturbed by rodents, cheatgrass (*Bromus tectorum*) was abundant. Precipitation in the general area did not differ appreciably from normal during the study period.

One hundred and thirty-five vigorous, mature Idaho fescue plants, each approximately 3 to 5 cm. in basal diameter, were selected from the abundant number growing on the study area. These were randomly assigned to nine separate treatments, yielding 15 replications per treatment.

The nine treatments consisted of all combinations of three levels of clipping and three degrees of competition. The three clipping levels for the selected fescue plants were "none," "heavy," and "extreme." The "none" level was an unclipped control. The "heavy" level of clipping consisted of 75 percent of the herbage volume removed at the flowering development stage (July 13), with no further treatment. The

"extreme" level consisted of 100 percent (to a 1-cm. stubble) of the herbage removed at flowering, followed by removing 75 percent of the regrowth near the seed-ripe developmental stage of the control plants (August 8). The plants were clipped during one growing season only.

The different degrees of competition were created immediately before the clipping treatments were begun. A degree of no ("none") competition was achieved by tilling the soil within a 60-cm. radius and from 5 to 8 cm. deep around the selected fescue plant. This tilling was combined with careful hoeing immediately adjacent to the plant to effectively remove all competing vegetation. Conceivably, such tillage might also increase aeration, infiltration, and nitrogen availability within the soil. The tilled areas were weeded periodically to maintain a competition-free condition throughout the study.

A degree of "partial" competition was created by clipping to ground level all vegetation within a 60-cm. radius of the selected fescue plants. This was done only at the time the fescue plants were first clipped in July; the competing vegetation was then permitted to regrow without further hindrance. The partial reduction treatment might be considered somewhat similar to very heavy grazing of all competing vegetation, followed by complete rest.

"Full" competition was obtained by allowing the undisturbed vegetation to remain around the selected fescue plants.

Plant response was evaluated shortly after flowering in 1968 by measuring live basal area (total basal area minus unoccupied openings), leaf length, and number and length of flower stalks. An index of herbage volume production was obtained by multiplying live basal area by average leaf length. These data were subjected to an analysis of variance (Snedecor 1959; 12.5),[3] followed by a comparison of treatment means by Keul's test (Snedecor 1959; 10.6).[3]

[3] *Snedecor, George W. Statistical methods. 534 pp. Ames, Iowa: Iowa State College Press. 1959.*

MUEGGLER, W. F.

1970. Influence of competition on the response of Idaho fescue to clipping. USDA Forest Serv. Res. Pap. INT-73, 10 p.

Partly reducing competition surrounding unclipped fescue increased herbage volume 40 percent and flower stalks 300 percent; eliminating competition tripled volume and increased flower stalks fourfold. The depressant effects of heavy clipping were more than eliminated by partly reducing competition. Eliminating competition more than offset the detrimental effects of extreme clipping.

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Results

As expected, increasing the severity of clipping and of competition successively decreased the growth and vigor of Idaho fescue during the year following treatment (figures 1 and 2).

Subjecting Idaho fescue to extreme clipping while under full competition reduced herbage volume the following year by 84 percent. Extreme clipping under both partial and no competition reduced herbage volume 66 and 47 percent, respectively, when compared with the unclipped plants under both partial competition and no competition. Thus, the relative depressant effects of clipping were lessened when competition was reduced.

The normally suppressing effect of competition on individual plants of Idaho fescue is clearly shown by the volume

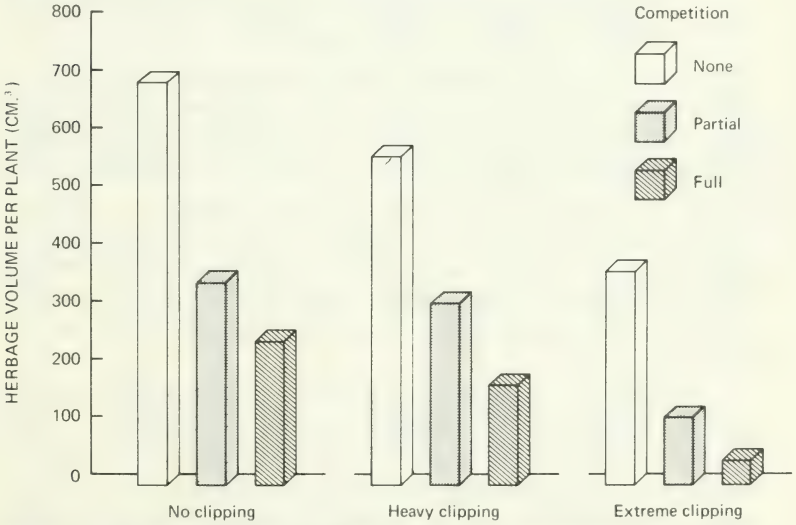

Figure 1. Herbage volume production of Idaho fescue the year following clipping under different levels of competition. (The column third from the left represents volume of check plants — no clipping, full competition.)

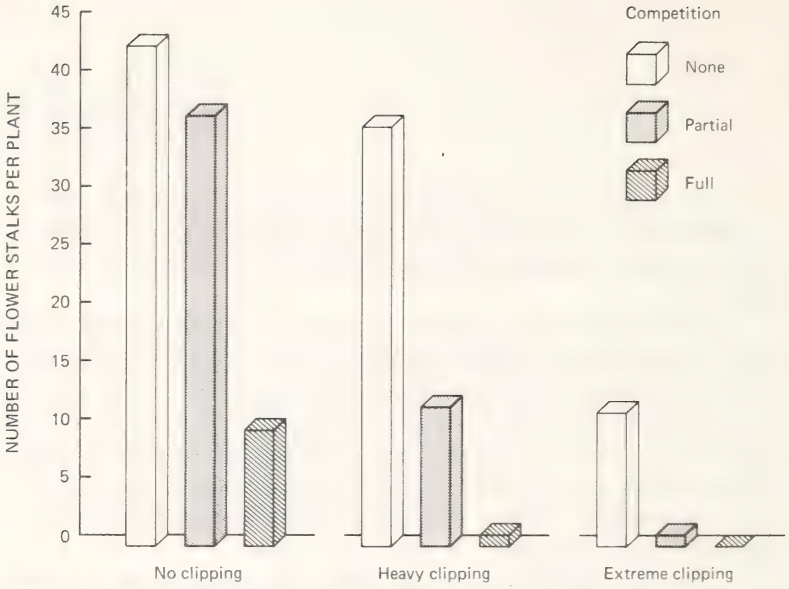

Figure 2. Flower stalk production of Idaho fescue the year following clipping under different levels of competition. (The column third from the left represents flower stalk numbers of check plants — no clipping, full competition.)

data for the unclipped plants that were subjected to different competition treatments (figure 3). Unclipped plants freed from competition almost tripled their volume in 1 year. Relative volume differences are even more pronounced when the plants are placed under the additional stress of clipping. Plants clipped to an extreme degree and without competition produced nine times more herbage than those subjected to full competition. Interestingly, elimination of competition more than compensated for the very harmful effects of extreme clipping.

The length of Idaho fescue leaves was affected more by differences in clipping intensity than by differences in competition (figure 3). Competition alone did not noticeably affect leaf length. However, the dual effect of competition and clipping reduced leaf length up to 40 percent. The response of average leaf length to the various treatment combinations closely paralleled that of maximum leaf length. Increased herbage volume that was caused only by reductions in com-

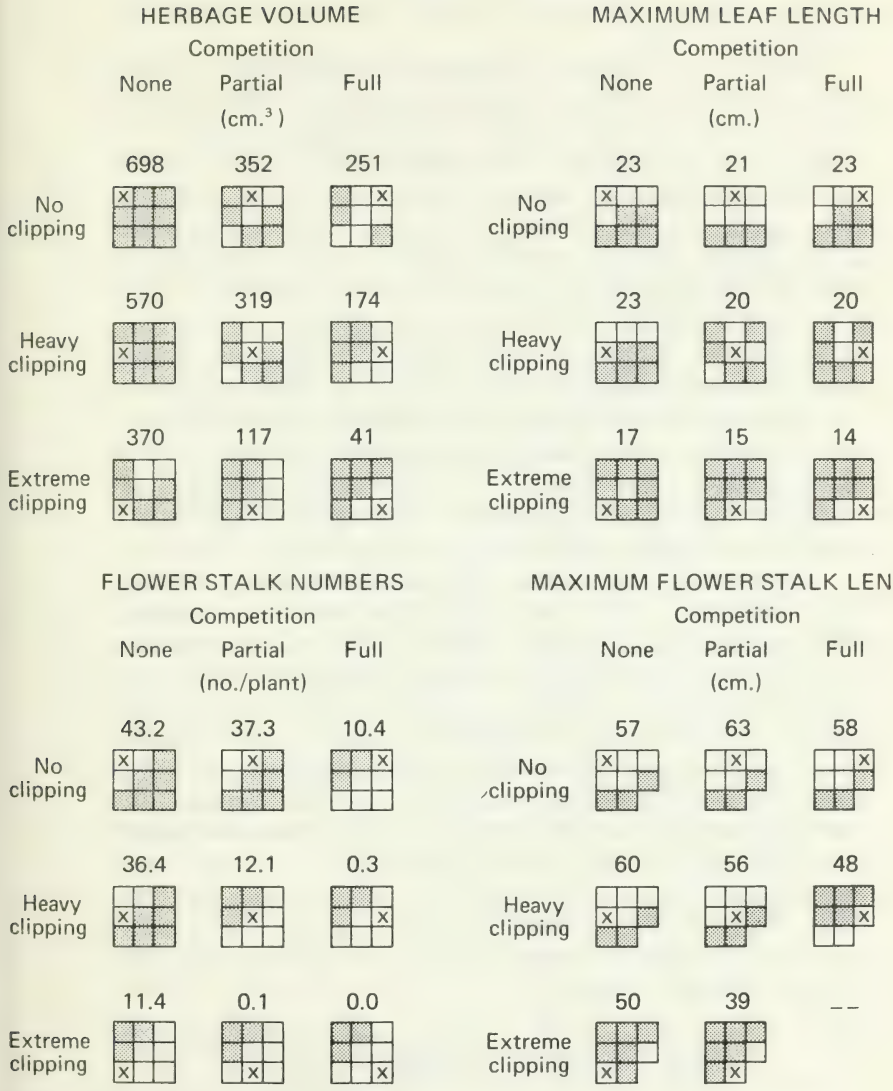

Figure 3. Herbage volume, number of flower stalks, and maximum leaf and flower stalk lengths of Idaho fescue the year following clipping and competition treatments.

petition reflected increased live basal area rather than increased plant height.

Each of the treatments, clipping and competition, affected the number of flower stalks produced by Idaho fescue very similarly (figures 2 and 3). Plants clipped heavily and extremely while subjected to the added stress of full competition virtually failed to flower. Even under partial competition, plants extremely clipped still produced virtually no flower stalks, but the heavily clipped plants produced as many flower stalks as the check plants that received no clipping and full competition. Flower stalk production was even better under no competition where even the extremely clipped plants produced as many flower stalks as the check plants.

Reducing natural competition obviously enhances flower stalk production. Eliminating competition permitted a fourfold increase in the number of flower stalks produced by unclipped plants; even partially reducing competition increased flower stalk production almost as much.

Flower stalk lengths were affected much less by clipping than were flower stalk numbers (figure 3). The combined detrimental effects of heavy clipping and full competition reduced both maximum and average flower stalk lengths by 17 percent. When competition was reduced, only extreme clipping caused a significant reduction in flower stalk lengths. Competition reductions alone did not significantly affect flower stalk lengths. Thus, neither flower stalk lengths nor leaf lengths appear to reflect vigor in Idaho fescue as readily as herbage volume and flower stalk numbers.

Although none of the fescue plants died under even the most severe treatment, many failed to produce flower stalks (table 1); this was particularly true for plants that were subjected to extreme clipping.

Table 1. — Percentage of Idaho fescue plants producing flower stalks the year following clipping and competition treatments

Clipping	Competition		
	None	Partial	Full
None	100	100	100
Heavy	100	100	20
Extreme	73	7	0

Discussion

This study demonstrates how effectively competition restricts growth of Idaho fescue. A partial removal of competition stimulates a substantial increase in herbage volume; elimination of competition permits a very great increase in volume. However, only a partial reduction in competition is almost as effective as complete elimination for increasing flower stalk production since both treatments nearly quadrupled the number of flower stalks.

Leaf and flower stalk lengths appear to be relatively rigid characteristics of Idaho fescue. Neither changed when plant vigor was increased by reducing competition. Apparently, under a normal climatic regimen, healthy Idaho fescue plants achieve their potential height growth even under the stress of full competition from associated vegetation.

Although heavy clipping is very detrimental to herbage production, it is even more harmful to flower stalk production. Leaf and flower stalk lengths are also reduced by heavy clipping, but these changes are relatively small compared to changes in herbage volume and flower stalk numbers. Since the number of flower stalks also increases most readily following reductions in competition, this characteristic is apparently a better indicator of Idaho fescue vigor than either leaf length, flower stalk length, or herbage volume.

The detrimental effects of clipping on Idaho fescue become progressively less as competition decreases. For example, extreme clipping reduced herbage volume the following year about 85 percent under full competition, 65 percent under partial competition, and 45 percent under no competition. Elimination of competition completely offsets the ef-

fect of extreme clipping on both volume and flower stalk production. A partial reduction of competition, as achieved in this study, more than compensates for the detrimental effect of heavy clipping.

These data exemplify the need for caution when applying results from clipping studies to plants being grazed on the range. The level of competition to which a plant is subjected during clipping trials can greatly influence actual herbage and flower stalk production; even the relative effects of different clipping intensities might be altered. If possible, studies simulating grazing of individual species should be conducted under conditions of competition similar to those encountered in the plant community where the results will be applied.

The results of this study imply certain considerations in managing Idaho fescue rangelands. Idaho fescue can withstand at least occasional heavy removal of its herbage if the surrounding vegetation is also used heavily. However, this is only part of the knowledge required for the formulation of sound management procedures. The response of plants, soils, and animals to repeated high-intensity use is of major importance. This has yet to be determined.

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